APPENDIX F
OPERATIONS, MONITORING, AND MAINTENANCE PLAN

APPENDIX F
OPERATIONS, MONITORING, AND MAINTENANCE PLAN
BASIS OF DESIGN REPORT
JORGENSEN FORGE EARLY ACTION AREA

Prepared for

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LIST OF ACRONYMS AND ABBREVIATIONS

Action Memo	*Action Memorandum for a Non-Time-Critical Removal Action at the Jorgensen Forge Early Action Area of the Lower Duwamish Waterway Superfund Site in Seattle, Washington*
ANOVA	Analysis of Variance
AOC	Administrative Order on Consent
BODR	Basis of Design Report
Boeing	The Boeing Company
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cm	centimeter
COC	chemical of concern
CQAP	Construction Quality Assurance Plan
cy	cubic yard
DSOA	Duwamish Sediment Other Area
EAA	Early Action Area
EMJ	Earle M. Jorgensen Company
EPA	U.S. Environmental Protection Agency
Facility	Jorgensen Forge facility
FSP	Field Sampling Plan
H:V	Horizontal to vertical
Jorgensen Forge	Jorgensen Forge Corporation
LDW	Lower Duwamish Waterway
mg/kg-OC	milligrams per kilogram (parts per million) organic carbon normalized
MLLW	mean lower low water
MOU	Memorandum of Understanding
NTCRA	non-time critical removal action
OMMP	Operations, Monitoring, and Maintenance Plan
Owner	EMJ and Jorgensen Forge
PCB	polychlorinated biphenyl

QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
RAB	Removal Action Boundary
RAWP	Removal Action Work Plan
RvAL	Removal Action Level
SAP	Sampling and Analysis Plan
SOW	Statement of Work
SMS	Sediment Management Standards

1 INTRODUCTION

This Operations, Monitoring, and Maintenance Plan (OMMP) has been prepared on behalf of Earle M. Jorgensen Company (EMJ) and Jorgensen Forge Corporation (Jorgensen Forge; herein referred to collectively as the Owner) pursuant to the Administrative Settlement Agreement and Order on Consent for Removal Action Implementation (AOC; U.S. Environmental Protection Agency [EPA] Region X Comprehensive Environmental Response, Compensation, and Liability Act [CERCLA] Docket No. 10-2012-0032) and attached Statement of Work (SOW). This OMMP is an appendix to the Basis of Design Report (BODR) Final Design submittal for the cleanup of contaminated sediments and associated bank soils in a portion of the Lower Duwamish Waterway (LDW) Superfund Site adjacent to the Jorgensen Forge facility (Facility) located in Tukwila, King County, Washington (Figure 1; Jorgensen Forge Early Action Area [EAA]).

Construction activities planned as part of the cleanup include in-water dredging, placement of in-water backfill and shoreline materials, reconfiguring the shoreline bank, and transport and off-site disposal of impacted sediments and soils. The cleanup will be conducted as a non-time-critical removal action (NTCRA) in accordance with EPA's selected cleanup alternative documented in the *Action Memorandum for a Non-Time-Critical Removal Action at the Jorgensen Forge Early Action Area of the Lower Duwamish Waterway Superfund Site in Seattle, Washington* (Action Memo; EPA 2011) and detailed in the *Final Engineering Evaluation/Cost Analysis [EE/CA]– Jorgensen Forge Facility, 8531 East Marginal Way South, Seattle, Washington* (Anchor QEA 2011).

The limits of the Jorgensen Forge EAA (herein referred to as the Removal Action Boundary [RAB]) are shown on Figure 2. The RAB extends from the top of the bank at approximately 19 to 20 feet mean lower low water (MLLW) (or top of the sheetpile/concrete panel on the southern portion of the Facility) to the federal navigation channel. The RAB is bounded to the north by The Boeing Company (Boeing) Plant 2 Duwamish Sediment Other Area (DSOA) and Southwest Bank Corrective Measure EAA cleanup area, as specified in the EPA-approved Memorandum of Understanding (MOU; EMJ 2007). EPA identified this cleanup area as the northern portion of the Jorgensen Forge EAA.

The removal action consists of the following elements:

- **Sediment Dredging**. Removal of the complete vertical and lateral extents of sediments exceeding the identified polychlorinated biphenyl (PCB) removal action level (RvAL; EPA 2008b) using barge-mounted equipment. Because the complete extents of total PCB RvAL exceedances and other co-located chemical exceedances will be removed, the removal action does not include a requirement for chemical isolation and the backfill material does not need to provide this function.
- **Sediment Backfilling**. Placement of imported clean fill material in removal areas to bring these areas back up to near the existing grade and elevation.
- **Shoreline Bank Reconfiguration**. Excavation of shoreline bank debris and sediments/soils to support greater slope stability and containment of the shoreline bank with imported clean materials; this work is planned to be conducted "in-the-dry" to the extent possible based on tidal elevations encountered during completion of the removal action.

1.1 Objectives of the OMMP

The general objectives of the OMMP are to develop long-term monitoring and maintenance requirements for the removal action to confirm that performance standards are being met in the years following construction, and to demonstrate that upland source controls at the Facility are effectively minimizing the potential for sediment recontamination.

The specific objectives of the OMMP are listed in Section II.2.1.1 of the SOW and include the following:

1. Establish baseline conditions for assessing the success of the NTCRA[1]
2. Monitor the predicted natural recovery of sediments[2]
3. Evaluate the effectiveness of source control, natural recovery, sediment removal, and thin-layer placement remedial actions[3]
4. Evaluate contaminant concentration levels or changes in sediment quality

[1]Baseline conditions will be established using post-construction surveys as specified in the Construction Quality Assurance Plan (CQAP; Appendix D to the BODR).

[2] Natural recovery is not a technology included in the EPA-approved removal action (EPA 2011). Rather, the changes in surface sediment quality in the new clean backfill surface within the RAB will be monitored over time to evaluate the anticipated increases in concentrations due to ongoing offsite sources in the LDW.

[3] Natural recovery and thin-layer placement are not components of the NTCRA.

5. Specify maintenance requirements for any structural components or structural soil/rock systems for the long-term protection of covered or contained areas, if applicable
6. Establish a schedule of inspections and monitoring
7. Define objective criteria for determining if maintenance is necessary based on monitoring results

1.2 Performance Standards

A summary of the proposed standards that will be used to evaluate the long-term performance of the removal action is provided below.

Sediment Recontamination. Clean imported sediments will be placed throughout the entire in-water and shoreline bank areas in the RAB following completion of the removal action. Over time, this clean sediment surface is expected to increase in concentration due to migration of chemicals from ongoing off-site sources in the LDW. The changes in surface sediment concentration within the RAB will be evaluated relative to areas outside the RAB through the collection and chemical analysis of surface sediment concentrations over time.

Shoreline Bank Containment Integrity. The shoreline bank area of the RAB will be contained with a 1.5-foot filter material layer overlain by a 2.5-foot riprap material layer, further overlain by a 0.5-foot layer of habitat substrate. The integrity of this containment will be maintained over the long term. Specifically, the bank will be inspected for significant signs of sloughing or erosion. Note that the intent of the habitat substrate is to allow it to naturally accrete or erode; it will not be specifically maintained.

1.3 Organization of the OMMP

The remainder of this OMMP is organized as follows:

- **Section 2** - Project Description
- **Section 3** - Monitoring of Dredging Area
- **Section 4** - Monitoring of Sediment Quality in Dredging Area
- **Section 5** - Monitoring of Shoreline Area
- **Section 6** - Potential Response Actions

- **Section 7** - Reporting

The three primary monitoring activities for the OMMP are described in Sections 3, 4, and 5. Monitoring objectives, schedules, and methods, including the type, number, location, and frequency of samples or measurements are presented in these sections. Section 6 describes the potential response actions that will be evaluated if long-term performance standards are not achieved. Section 7 presents the OMMP reporting requirements.

2 PROJECT DESCRIPTION

Design elements of the removal action are provided in the BODR and summarized in this section. The elements of the removal action are shown on Figure 2 and consist of the following activities:

- Shoreline bank excavation and slope containment (intertidal)
- Sediment dredging and backfilling (subtidal)

2.1 Sediment Dredging and Backfilling

As detailed in the BODR, the removal action includes dredging of all subtidal sediments with concentrations greater than the Washington State Department of Ecology (Ecology) Sediment Management Standards (SMS) PCB criterion (12 milligrams per kilogram normalized for organic carbon content [12 mg/kg-OC]). This total PCB criterion is referred to as the RvAL in this OMMP consistent with the BODR and Action Memorandum (EPA 2011). The target dredge elevations will be based on existing subsurface core data in the RAB showing RvAL exceedances. Based on current information, the dredge cuts will vary in thickness between 1 and 11 feet, and the contractor will be allowed an additional overdredge tolerance of 2 feet. Approximately 10,800 cubic yards (cy) of material is required to be removed during dredging.

Note that areas within 10 feet of the navigation channel in the RAB will not be fully backfilled to its current grade in consideration of future navigational dredging needs in the federal navigation channel. Also, dredging adjacent to the abutted sheet pile and concrete panel walls will be offset by 5 feet to minimize potential impacts to the structural stability of the walls. That 5-foot strip will be covered with a minimum of 18 inches of clean material.

Dredging will be followed by the placement of clean import material to bring the area back generally to its existing grade. The clean backfill material will consist of sand and gravel mixture that meets EPA-approved chemical criteria.

2.2 Shoreline Bank Excavation and Slope Containment

The shoreline bank will be excavated to remove debris and underlying affected nearshore soil/sediment, followed by the placement of 4-foot-thick slope containment (Figure 2). The

slope containment is designed to promote slope stability, enhance habitat, and contain underlying soil/sediment materials. The shoreline bank reconfiguration extends from the top of the existing bank from approximately 19 to 20 feet MLLW down to -8 feet MLLW elevation.

The excavation is proposed to occur over a total distance of approximately 570 linear feet of shoreline. The design excavation depth is between 1 and 11 feet (including 1 feet over-excavation tolerance) shoreward of the existing ground surface from the toe of slope upwards, and the finished bank will be reconfigured to a gentler, more stable 2 horizontal to 1 vertical slope (2H:1V; Figure 2). The excavation will result in the required removal of approximately 5,400 cy of impacted soil/sediment, fill material, and debris.

Following excavation, slope containment materials will be placed along the full length and height of the reconfigured slope. The containment will be composed of three layers: a target 1.5-foot "filter" layer (sandy gravel to gravelly sand), overlain by a target 2.5-foot riprap material, and finished with a target 0.5-foot habitat layer (anticipated to consist of rounded or sub-rounded, 2.5-inch minus gravel). The filter layer will act as the chemical isolation layer, the riprap layer will protect the filter layer from erosion, and the habitat layer will provide enhanced substrate for benthic invertebrates and salmonids. Application of the slope containment will result in the placement of approximately 2,500 cy of filter material, 3,800 cy of riprap material, and 1,300 cy of a habitat material (for a total placement volume of approximately 7,600 cy) over approximately a total of 0.75 acres.

3 MONITORING OF BACKFILL IN DREDGING AREAS

Visual monitoring of the backfill area will be performed in intertidal areas following dredging and backfilling to confirm that significant erosion or sloughing is not occurring in the years following the removal action (Figure 2). Because the complete vertical and lateral extents of total PCB RvAL exceedances and other co-located chemical exceedances will be removed, the removal action does not include a requirement for chemical isolation and the backfill material does not need to be monitored for this function.

3.1 Monitoring Objectives and Approach

The objective of visual monitoring the intertidal dredge and backfill areas is to confirm that the backfill material is generally remaining in place and that sloughing or other evidence of slope instability is not occurring. This objective will be achieved by visual surveys at low tide. Monitoring of subtidal dredge and backfill areas is not necessary since any significant slope instability in the backfill area would be identified during the visual monitoring performed in the intertidal areas during low tide.

3.2 Monitoring Methods, Locations, and Frequency

3.2.1 Monitoring Methods

A visual survey will be performed from land at a spring low tide when tides are typically at the lowest elevations of the year. Photos taken from fixed observation points will determine if any dredge and backfill areas are sloughing or other visual signs of slope instability are evident. Any areas of instability will be noted on figures and contingency and response actions will be taken as necessary as described in Section 6.1. Photos taken during the first year of monitoring will serve as a baseline for future monitoring.

3.2.2 Monitoring Locations

The density and specific location of fixed observation points will be determined in the first year of monitoring after final backfill grades and site access routes have been established. It is anticipated that the observation points will be established in the backfill area at elevations at or above -2 feet MLLW.

3.2.3 Monitoring Frequency

Visual surveys of dredge and backfill areas will be performed in Year 1, 3, 5, 7, and 10, following the completion of the removal action. Visual surveys will be performed during a spring low tide to the extent practicable to maximize the coverage of the survey area.

Monitoring reports will include color photos of a reasonable size to interpret the conditions and a discussion of any evidence of sloughing or instability in the backfill material. As discussed in Section 6.1 below, recommendations for additional slope stabilization measures will also be included, if necessary.

4 POST-CONSTRUCTION MONITORING OF SEDIMENT QUALITY IN DREDGING AREAS

Long-term monitoring of the chemical quality of surface sediments in the RAB will be performed as described below. The complete vertical and lateral extents of total PCB RvAL exceedances and other co-located chemical exceedances will be removed in the RAB so this monitoring will serve to document anticipated increases in surface sediment chemical concentrations over time due to off-site ongoing releases in the LDW and evaluate potential recontamination from ongoing Facility operations.

4.1 Monitoring Objectives and Approach

Post-construction surface sediment monitoring will be performed in the RAB to evaluate the changes in surface sediment concentration over time. Consistent with the SMS, the surface sediment samples will be collected from within the top 10 centimeters (cm) below the mudline.

To evaluate changes in surface sediment concentrations within the RAB, six surface sediment samples will be collected within the dredging area (Figure 3). Surface sediment locations are distributed to achieve spatial coverage and target potential sources of recontamination within the RAB. Figure 7 of the BODR presents subsurface sediment total PCB concentrations within the RAB. Five of the surface sediment locations are co-located with existing subsurface sampling locations with relatively high PCB concentrations. A sixth surface sediment sample (LTR-4) is specifically located to monitor potential sediment quality impacts from the discharge area of the new outfall that will be constructed during the removal action. Surface sediment samples collected within the RAB will be submitted for chemical analysis for the chemicals of concern (COCs) described in Section 4.2.

Surface samples will also be collected from two other areas, including one immediately adjacent area outside the RAB within the navigation channel and one area upstream of the RAB. Samples collected from the upstream and navigation channel areas will be archived to support potential future analysis of off-site source impacts to the RAB, if necessary.

The Boeing Plant 2 DSOA corrective action will occur directly downstream of the RAB following completion of the removal action in the RAB. Boeing will implement a separate

perimeter monitoring plan to address releases from the DSOA corrective action as described in the Pre- and Post-Construction Perimeter Sediment Monitoring Plan (AMEC 2012). Therefore, no downstream perimeter sample collection is proposed in this OMMP.

4.2 Monitoring Methods, Locations, and Frequency

4.2.1 Surface Sediment Sampling Methods

Surface sediment samples from all locations shown in Figure 3 (including R, U, and N samples, as described in Section 4.2.2, below) will be collected using a van Veen grab sampler or equivalent deployed from a winch line on a sampling vessel. All individual grab samples will be collected from the top 10 cm below mudline.

Detailed procedures for field sampling, location control, sample handling, and decontamination are provided in the Field Sampling Plan (FSP) for this project (see Appendix I to the BODR). In areas where riprap has been placed as part of the shoreline containment, collection of surface grab samples may not be possible. As described in the FSP, sample locations will be excluded from the analysis if sample collection is unsuccessful after three attempts.

Detailed field and laboratory quality assurance and quality control criteria, including method specifications, detection limits, accuracy and precision requirements, are provided in the Quality Assurance Project Plan (QAPP) for this project (see Attachment 1 of Appendix I to the BODR).

4.2.2 Surface Sediment Sample Locations

The proposed long-term surface sediment sample locations are shown on Figure 3. Surface sediment grab samples are systematically distributed within the following three different monitoring areas to evaluate potential sources of recontamination, including one area within the RAB, one immediately adjacent area outside the RAB, and one area upstream from the RAB:

- Subtidal and intertidal areas within the RAB (R)
- Federal navigation channel immediately adjacent and upstream of RAB (N)
- Subtidal and intertidal areas immediately upstream of RAB (U) as well as further

upstream in vicinity of river mile (RM) 3.8 EAA and upstream of the EAA

As shown in Figure 3, six individual surface sediment samples will be collected from each of the sediment monitoring areas R, U, and N, resulting in a total of 18 samples. The samples will be submitted for chemical analysis or archived as described in the following sections.

The target sample coordinates for each of the sediment grab sample locations are listed in Table 1.

4.2.3 Chemical Analytical Parameters

The sediment samples collected from sediment monitoring area R will be submitted for the following list of chemical and conventional parameters:

- Total PCBs
- Total organic carbon
- Metals
- Total solids
- Grain size

The remaining samples from sediment monitoring areas U and N will be archived. These archived samples will be kept in frozen storage at the analytical laboratory pending potential future analysis.

4.2.4 Monitoring Frequency

A post-construction sediment sampling event will be conducted in sediment monitoring areas U and N as part of the CQAP activities (see Appendix D of the BODR) to verify the final "as built" quality of the sediment surface following the removal action construction completion. Sediment sampling conducted as part of the OMMP will be performed in sediment monitoring area R concurrently with this CQAP sampling. This CQAP and OMMP data will serve as the Year 0 baseline condition and the comparison endpoint for future OMMP surface sediment monitoring data.

Subsequent sampling will be conducted in all sediment monitoring areas shown in Figure 3 in Years 1, 3, 5, 7, and 10 following the completion of the removal action. The monitoring schedule will be re-evaluated in consultation with EPA after the first two events are completed and analyzed. The monitoring frequency may be decreased if sediment concentrations are consistently below SMS Sediment Quality Standard criteria and show relatively insignificant changes over time. Additional monitoring may be conducted if a significant documented release occurs from the Facility to the LDW.

5 POST-CONSTRUCTION MONITORING OF SHORELINE BANK AREA

Post-construction visual monitoring of the reconfigured shoreline bank will be conducted during spring low tide in the area identified as "Reconfigured Bank Visual Monitoring Area" shown on Figure 3. To the extent possible, visual monitoring of the shoreline bank areas will occur concurrently with monitoring of the backfill area.

5.1 Monitoring Objectives and Strategy

The objective of visual monitoring within the shoreline bank area is to verify that slope containment remains generally stable and there are no significant signs of riprap movement, sloughing, or erosion. In addition, the condition and coverage of the 6-inch habitat cover layer will be visually assessed. Note that the intent of the habitat cover layer is to allow it to naturally accrete or erode so this layer is anticipated to migrate and come to equilibrium based on the encountered forces (e.g., LDW discharge, waves, or propeller wash).

5.2 Monitoring Methods, Locations, and Frequency

5.2.1 Containment Stability Survey Methods

A visual survey of the shoreline bank area will be completed that will look for evidence of sloughing and erosion to ensure that the function and integrity of the shoreline containment is being maintained. Transects will be established on 100-foot centers perpendicular to the shoreline (approximately 6 transects) to provide a fixed frame of reference from one monitoring event to the next. Observers will walk the top of the shoreline bank and visually observe the areas above the waterline and document any evidence suggesting erosion or instability of the riprap layer relative to the nearest transect. Any areas of erosion or instability will be noted on figures relative to the transect locations.

A visual survey of the habitat layer will be completed to estimate the coverage of the habitat material over the riprap. Observers will walk the entire top of shoreline bank area looking for areas of erosion or accretion. The estimated percent coverage of riprap by the habitat layer, areas of exposed riprap, and the estimated thickness of the habitat layer will be recorded relative to the transect locations.

5.2.2 Shoreline Evaluation

If significant signs of erosion of the riprap material or bank instability are observed, contingency response actions will be evaluated, as described in Section 6.

Because the habitat cover layer is expected to naturally accrete or erode in response to the encountered forces (e.g., LDW discharge, waves and propeller wash), the loss of this material from the shoreline area will not trigger a response action.

5.2.3 Shoreline Monitoring Frequency

Visual monitoring of the shoreline area at spring low tide will be performed in Years 1, 3, 5, 7, and 10 following the completion of the removal action. To the extent possible, visual monitoring of the shoreline area will be performed concurrently with visual monitoring of the backfill area described in Section 3. Contingent visual monitoring of the shoreline area will be performed in response to a storm event or flood event of 25-year return period or greater, if one happens to occur in the LDW during the post-construction OMMP monitoring period.

6 CONTINGENCY RESPONSE ACTIONS

This section describes potential response actions that will be undertaken if monitoring results indicate the long-term performance standards identified in Section 1.2 are not being achieved.

There are four potential issues with the long-term integrity of the removal action that would warrant an evaluation of response actions, including:

- Significant erosion, sloughing or instability of the backfill material
- Recontamination within the RAB from Facility releases
- Erosion or instability of the shoreline containment area
- Earthquake of 100 recurrence interval or greater

Potential response actions for each of these scenarios are discussed below.

6.1 Significant Erosion, Sloughing, or Instability of the Backfill Material

If significant signs of erosion, sloughing, or significant downslope movement of the backfill material are observed, a geotechnical engineer will assess the slope configuration to determine the severity of the instability and whether ongoing failures are likely. If additional slope stabilization measures are deemed necessary, cost-effective alternatives will be discussed with EPA.

Note that the primary objective of any response action will be to correct sloughing or slope instability concerns. The complete vertical and lateral extents of total PCB RvAL exceedances and other co-located chemical exceedances will be removed so the backfill material is not designed to perform as a chemical isolation layer.

6.2 Recontamination within the RAB from Facility Releases

It is expected that surface sediment COC concentrations within the RAB will increase over time from the post-construction baseline as chemical concentrations approach equilibrium with ongoing off-site source loadings in the LDW. As described in Sections 4 and 5, samples will be collected both within the RAB and in the adjacent areas within the LDW (see the

three monitoring areas shown Figure 3) to document whether the surface sediment concentration increases in the RAB are sourced from the Facility versus off-site LDW-wide sources. If the data suggest increased surface sediment concentrations above the applicable EPA-approved risk based concentrations are due to Facility releases, the following sequence of contingency response actions will be initiated:

- An additional round of sediment testing will be conducted immediately to confirm the results. The sediment testing locations may be revised from those identified in Figure 3 to target potential release areas. If recontamination from Facility sources is not confirmed, monitoring will resume according to the regular OMMP schedule.
- If recontamination from Facility sources is also identified during the confirmation testing, the Owner and EPA, in coordination with Ecology, will review the data, in particular the nature and magnitude of the exceedance, and agree on an appropriate path forward. The path forward may include one or more of the following:
  - Sampling of the Facility stormwater discharge following treatment and discharge into the LDW
  - Increased frequency of sediment monitoring
  - Use of additional field measurements (e.g., bioassays, fish tissue samples) to evaluate site-specific risk
  - Application of a thin sand cover layer to the affected area
  - Upland source tracing and environmental monitoring to isolate and identify the source of contamination
  - Evaluation of additional cost-effective source control measures, potentially including enhanced or additional best management practices (BMPs), engineering or operational controls

6.3 Erosion or Instability of the Shoreline Bank Area

If the shoreline bank is determined to be unstable or is undergoing significant erosion such that it compromises the integrity of the shoreline containment, the following sequence of contingency actions will be initiated:

- Delineate the extent of the containment reduction
- Determine the cause of the instability
- Address the instability based on the findings. Measures to improve the stability of the

shoreline containment may include:

- Regrading of the slope
- Placement of a toe buttress
- Increasing the gradation and/or thickness of the riprap layer

If response actions are warranted, it may be necessary to monitor this area more frequently to observe the effectiveness of any shoreline repairs, to better understand the causative processes, and to quickly identify new areas of erosion if any should develop.

6.4 Earthquake of 100-Year Recurrence Interval or Greater

If an earthquake occurs with a 100-year recurrence interval or greater, the long-term monitoring procedures described in Section 3, 4, and 5 will determine whether significant erosion, sloughing, or instability of the backfill material occurred; whether Facility releases occurred that could have the potential to recontaminate the RAB; and, whether erosion or instability of the shoreline containment area may have occurred and potentially compromised the integrity of the shoreline containment. If any of the above conditions exist, the potential response actions identified in Sections 6.1, 6.2, and 6.3 will be triggered.

7 REPORTING

OMMP monitoring reports will be prepared following Year 1, 3, 5, 7, and 10 monitoring events, as well as any emergency monitoring events that may need to be conducted in response to a severe storm or flood or documented significant release from the Facility. Each monitoring report will be prepared and submitted to EPA within 90 days of receipt of final validated analytical results for that event. The reports will include a presentation and evaluation of all monitoring activities conducted during the monitoring year, and will be organized according to the three primary monitoring tasks described in Sections 3, 4, and 5 of this OMMP. Follow-up meetings with the Owner and EPA will be scheduled, as necessary, to review and discuss the monitoring results, in particular to agree on a path forward if contingency response actions are recommended. At a minimum, the monitoring reports will include the information summarized below.

7.1 General Reporting

Each monitoring report will generally contain the following information:

1. Summary of all field activities, including a description of any deviations from the FSP, QAPP, or OMMP, and reasons for the deviations.
2. Final Quality Assurance/Quality Control (QA/QC) report to ensure that data quality is sufficient to meet project objectives and support project decisions.
3. Electronic (PDF) copies of all relevant field and analytical data forms and reports, including QA/QC data.

7.2 Post-construction Monitoring of Backfill in Dredging Area

Each monitoring report will contain the following information regarding the monitoring results for the backfill in the dredge areas:

1. Summary of visual observations at low tide, specifically including evidence of sloughing or instability of the backfill with supporting photographic documentation.
2. Comparison of current conditions relative to prior monitoring events and the baseline condition.
3. Geotechnical analysis of current and future slope stability in the backfill areas, if required based on identified areas of sloughing or instability.

4. If warranted based on the results of the geotechnical analysis, recommendations to improve slope stability.

7.3 Post-construction Monitoring of Sediment Quality in Dredging Area

Each monitoring report will contain the following information regarding the monitoring results for sediment quality in the dredge areas:

1. Maps and tables showing actual locations of surface sediment sampling stations in state plane coordinates to the nearest foot.
2. Summary table of validated sediment analytical results.
3. Summary of changes in sediment quality within the RAB relative to any potential adjacent and/or upstream areas that are submitted for chemical analysis.

7.4 Post-construction Monitoring of Shoreline Bank Area

Each monitoring report will contain the following information regarding the monitoring results for the shoreline bank areas:

1. Summary of visual observations at low tide relative to transect locations, specifically including evidence of erosion of the shoreline containment and estimates of the relative coverage of habitat material, with supporting photographic documentation.
2. Comparison of current conditions relative to prior monitoring events and the baseline condition.
3. If erosion is observed, estimated areas and depths of erosion, and the affected shoreline containment layers (i.e., base layer, riprap layer), delineated on a plan map.
4. If possible, an assessment of the probable cause(s) of erosion.
5. If significant erosion is observed, recommendations regarding contingency response actions and a preliminary schedule for their implementation.

8 REFERENCES

AMEC, 2012. *Pre- and Post-Construction Perimeter Sediment Monitoring Plan. Duwamish Sediment Other Area and Southwest Bank Corrective Measure and Habitat Project, Boeing Plant 2, Seattle/Tukwila, Washington*. May 2012.

Anchor QEA, 2011. *Final Engineering Evaluation/Cost Analysis – Jorgensen Forge Facility, 8531 East Marginal Way South, Seattle, Washington*. Prepared for the U.S. Environmental Protection Agency. March 2011.

EMJ (Earle M. Jorgensen), Jorgensen Forge Corporation (Jorgensen Forge), and The Boeing Company (Boeing), 2007. *Memorandum of Understanding: Coordination at the Boeing and EMJ/Jorgensen Transition Zone Boundary Sediment Cleanup Areas; Lower Duwamish Waterway*. September 2007.

EPA (U.S. Environmental Protection Agency), 2008b. Letter with Subject: Target Remedial Sediment Boundary, Vertical Point of Compliance and Target Sediment Cleanup Level, Administrative Order on Consent, Jorgensen Forge Facility, Tukwila, Washington, Comprehensive Environmental Response, Compensation and Liability Act, as amended, EPA Docket No. CERCLA 10-2003-0111. Prepared for Mr. Peter Jewett of Farallon Consulting, LLC, and Mr. William Johnson of Earle M. Jorgensen Company. August 8, 2008.

EPA, 2011. Action Memorandum for a Non-Time-Critical Removal Action at the Jorgensen Forge Early Action Area of the Lower Duwamish Waterway Superfund Site in Seattle, Washington. Seattle, Washington.

TABLES

Table 1
Sediment Sampling Station Coordinates

Sediment Monitoring Area	Station ID	Northing	Easting
Subtidal Removal Area (R)	LTR-1	1275822.6	195624.0
	LTR-2	1275850.7	195510.5
	LTR-3	1275888.5	195458.6
	LTR-4	1275879.8	195363.8
	LTR-5	1275930.3	195367.9
	LTR-6	1275929.0	195180.7
Upstream (U)	PMU-1	1275966.1	195048.1
	PMU-2	1276023.2	195050.7
	PMU-3	1276036.5	194766.3
	PMU-4	1276116.1	194768.4
	PMU-5	1276136.4	194395.6
	PMU-6	1276219.3	194412.7
Navigation Channel (N)	PMN-1	1275774.8	195556.9
	PMN-2	1275826.8	195386.5
	PMN-3	1275860.4	195216.3
	PMN-4	1275852.9	195070.9
	PMN-5	1275941.8	194756.9
	PMN-6	1276033.0	194371.4

Note:
Horizontal Datum: WA SP NAD 83, North Zone, U.S. Feet

Table 2
Sampling Parameters, Analytical Methods, and Chemical Criteria

Parameter	Analytical Method	Units	Ecology 2003 Freshwater Sediment Management Standards		SAPA Recommended Practical Quantitation Limit (PQL)[b]	Laboratory PQL
			LAET	Sediment Quality Standards		
Conventional Parameters						
Grain size	PSEP, 1986	%	--	--	1	1.0
Total solids	PSEP, 1986	% wet wt	--	--	0.1	0.01
Total organic carbon (TOC)	PSEP, 1986	% dry wt	--	--	0.1	0.05
Metals						
Arsenic	6010B/6020	mg/kg dry wt	31.4	57	19	0.2
Cadmium	6010B/6020	mg/kg dry wt	2.39	5.1	1.7	0.2
Chromium	6010B/6020	mg/kg dry wt	95	260	87	0.5
Copper	6010B/6020	mg/kg dry wt	619	390	130	0.5
Lead	6010B/6020	mg/kg dry wt	335	450	150	0.2
Mercury	7471A	mg/kg dry wt	0.8	0.41	0.14	0.025
Silver	6010B/6020	mg/kg dry wt	0.545	6.1	2	0.2
Zinc	6010B/6020	mg/kg dry wt	683	410	137	4.0
Polychlorinated Biphenyks (PCBs)						
Total PCB Aroclors	8082	µg/kg dry wt	62	12 mg/kg OC	6	10

Notes:

a = 2-Methylnapthalene is not included in the sum of LPAHs

b = Washington State Department of Ecology Sediment Sampling and Analysis Plan Appendix, February 2008

c = Toxic Equivalents Quotients will be calculated using WHO 2005 Mammalian Toxicity Equivalency Factors with ND=DL, EMPC=EMPC, ND=DL/2, EMPC=EMPC

d = Units designated with "OC" are TOC normalized per Sediment Management Standards guidance; however, TOC values <0.5 percent or >3 percent will be not be OC normalized and screened against LAET criteria

2LAET = Second lowest apparent effects threshold

µg/kg = micrograms per kilogram

HPAH = high-molecular-weight polycyclic aromatic hydrocarbon

LAET = Lowest apparent effects threshold

LPAH = low-molecular-weight polycyclic aromatic hydrocarbon

mg/kg = milligrams per kilogram

ng/kg = nanograms per kilogram

FIGURES

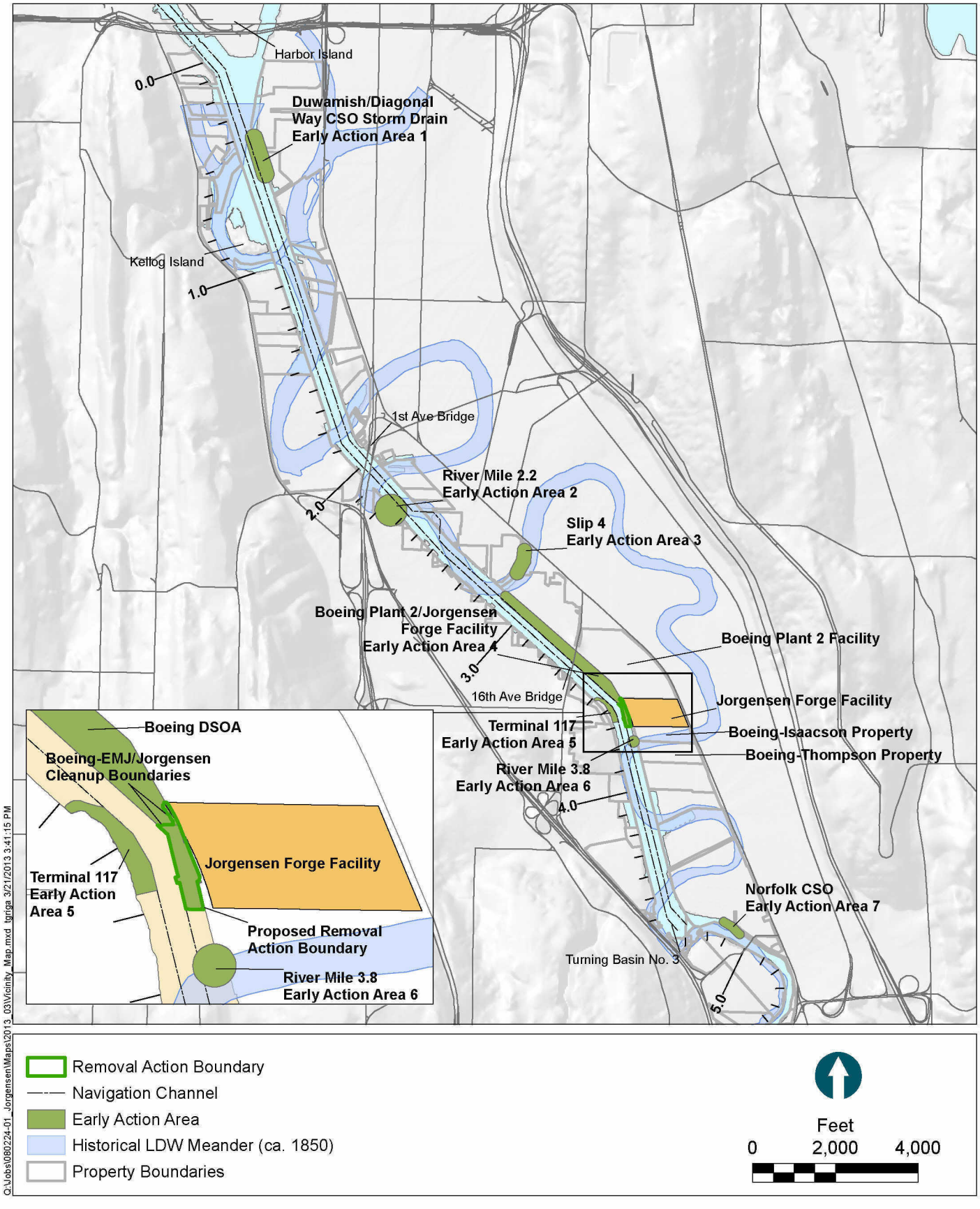

Figure 1
Removal Action Vicinity Map
Operation, Monitoring and Maintenance Plan
Jorgensen Forge Early Action Area

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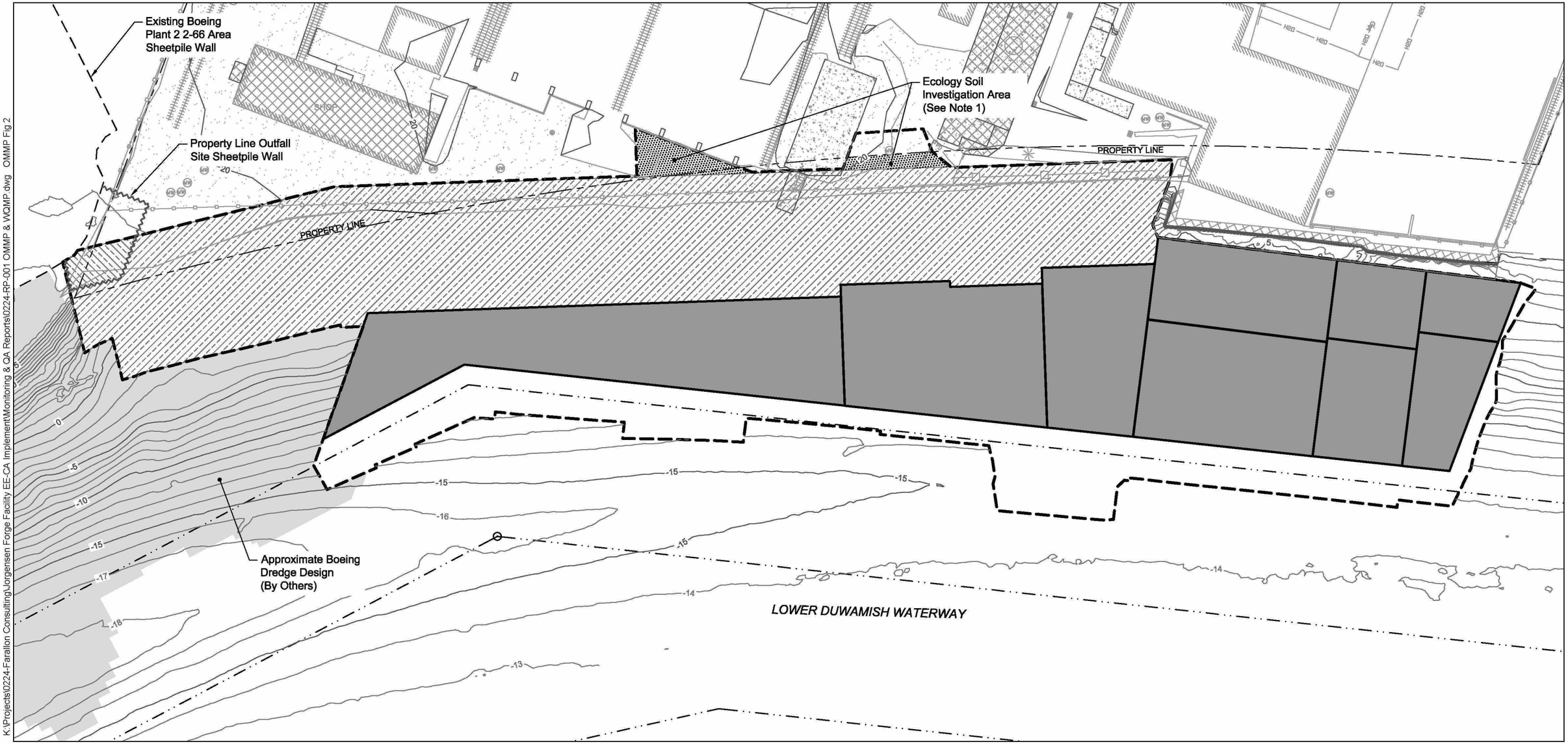

K:\Projects\0224-Farallon Consulting\Jorgensen Forge Facility EE-CA Implement\Monitoring & QA Reports\0224-RP-001 OMMP & WQMP.dwg OMMP Fig 2

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HORIZONTAL DATUM: Washington State Plane North, NAD83, U.S. Feet.
VERTICAL DATUM: Mean Lower Low Water (MLLW).
NOTES:

1. The Owner is removing additional soil and backfilling along the top of bank area surrounding soil borings SB-3 and SB-4 to remove relatively elevated concentrations of polychlorinated biphenyls. This work is not being performed under the EPA scope of work but rather as an Independent Action under the existing Ecology Agreed Order (No. DE 4127) at the facility.

LEGEND:

- Navigation Channel
- 5 — Existing Contour (1 Ft Interval)
- Dredge/Excavation Limits
- Backfill Material Placement Area
- Shoreline Containment Area

0 50
Scale in Feet

ANCHOR QEA

Figure 2
Removal Action Site Plan
Operations, Monitoring and Maintenance Plan
Jorgensen Forge Early Action Area

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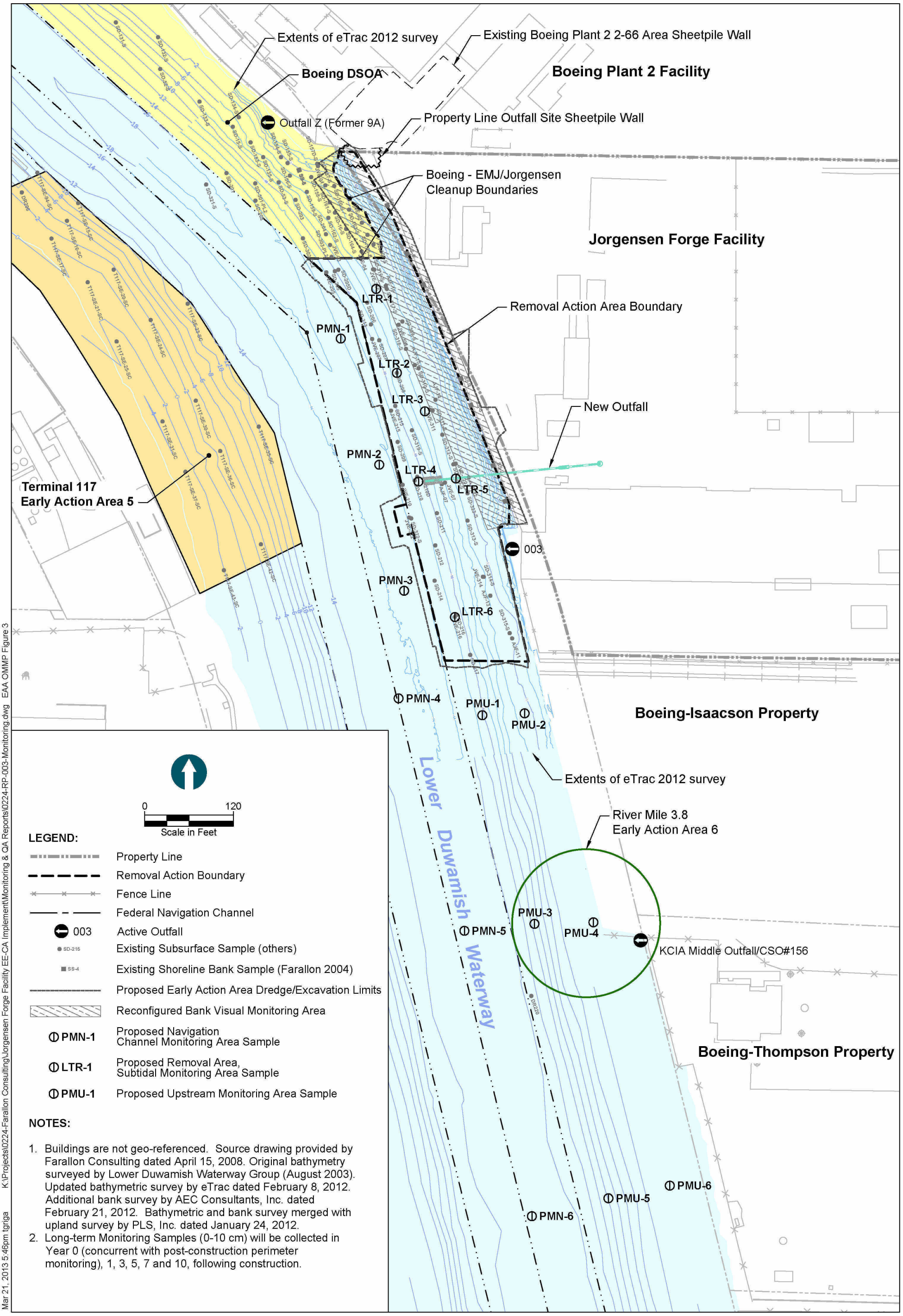

NOTES:

1. Buildings are not geo-referenced. Source drawing provided by Farallon Consulting dated April 15, 2008. Original bathymetry surveyed by Lower Duwamish Waterway Group (August 2003). Updated bathymetric survey by eTrac dated February 8, 2012. Additional bank survey by AEC Consultants, Inc. dated February 21, 2012. Bathymetric and bank survey merged with upland survey by PLS, Inc. dated January 24, 2012.
2. Long-term Monitoring Samples (0-10 cm) will be collected in Year 0 (concurrent with post-construction perimeter monitoring), 1, 3, 5, 7 and 10, following construction.

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Figure 3
Monitoring Station Locations
Operations, Monitoring and Maintenance Plan
Jorgensen Forge Early Action Area